

State of Montana Office of the Legislative Auditor

EDP Audit

UNIVERSITY OF MONTANA

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This report contains recommendations concerning the University of Montana's Computer Center operations and its data processing policies and procedures. These recommendations include:

- ▶ Improving data processing resource planning.
- ▶ Providing power protection for computers.
- ▶ Improving disaster recovery capabilities.
- ▶ Examining alternative locations for the U of M computer facility.
- ▶ Improving software development and maintenance policies and procedures.

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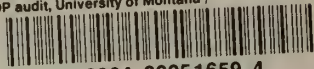
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March 1985

The Legislative Audit Committee
of the Montana State Legislature:

This is our EDP audit of University of Montana data processing activities.

The report contains recommendations concerning the University of Montana Computer Center and data processing activities. Agency responses are contained at the end of the report.

We wish to express our appreciation to the Fiscal Affairs Vice President and the staff of the Computer Center for their cooperation and assistance.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Scott A. Seacat".

Scott A. Seacat
Deputy Legislative Auditor

Approved:

A handwritten signature in black ink, appearing to read "Robert R. Ringwood".

Robert R. Ringwood
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ADMINISTRATIVE OFFICIALS

UNIVERSITY OF MONTANA

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SUMMARY OF RECOMMENDATIONS

The following is a listing of report recommendations together with a notation as to whether University of Montana officials concur or do not concur with each recommendation. This listing serves as a summary of report issues and as a reference to the supporting comments. The full response of the University of Montana is included in the back of this report beginning on page 29.

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CHAPTER I

INTRODUCTION

An EDP audit of University of Montana data processing activities was performed at the request of the Legislative Audit Committee. This report summarizes the results of our EDP audit.

OBJECTIVES OF AUDIT

The objectives of the EDP audit were to evaluate data processing controls at the University of Montana (UofM) and to determine if university data processing activities are being managed efficiently and effectively.

During our audit we asked university officials for responses on selected audit findings. These areas related to report issues and recommendations and were discussed with university personnel during the audit.

SCOPE OF AUDIT

The audit focused on the efficiency and effectiveness of UofM data processing activities and management of these activities. It did not include a review of the financial status of the university. In addition, we briefly examined university word processing activity during the audit. The audit was conducted in accordance with generally accepted governmental performance auditing standards.

COMPLIANCE

As part of our audit we reviewed compliance with UofM and Board of Regents policies related to data processing activities. We noted no significant areas of noncompliance. During the audit we identified specific areas where new policies or revisions of current policy are necessary. These areas are discussed in related report sections or in management memoranda. For items we did not test, nothing came to our attention that would indicate significant non-compliance.

MANAGEMENT MEMORANDA

Twelve management memoranda were issued during our audit. Through these memoranda we communicated to university management issues which were not significant enough to be included in the audit report but were such that UofM officials may wish to address them.

The twelve management memorandum issues included:

1. Password standards.
2. Gandalf dataswitch maintenance.
3. Placement of fire detection and suppression devices.
4. Security over data entry documents.
5. Datafile security.
6. Project control for system software modifications.
7. Timing of physical plant jobs.
8. Internal auditor involvement in software application development.
9. Software application documentation.
10. Choice of controls for software applications.
11. The Computer Center's project control system.
12. Segregation of application development access.

During the audit, the university's controller noted an interest in finding additional ways to collect past due accounts receivable. We offered to perform an experimental match between the university's past due accounts receivable file and the central payroll system. As a result of the match, 50 persons owing the university a total of nearly \$10,000 were identified.

CHAPTER II

BACKGROUND

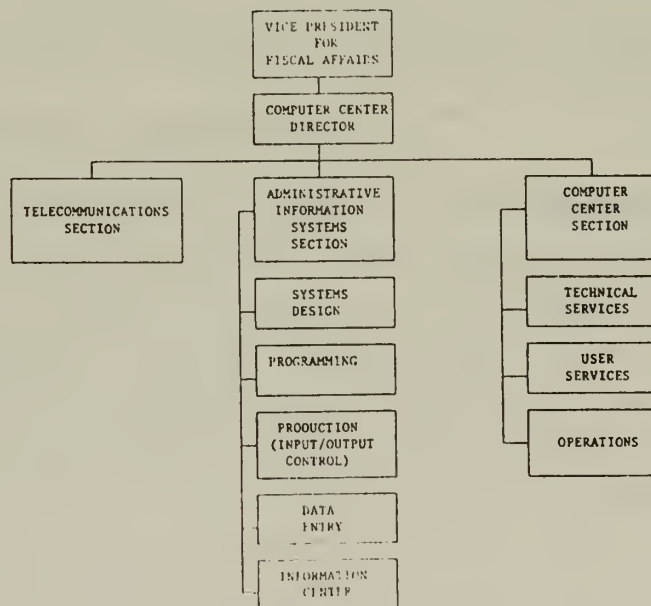
The UofM Computer Center was formed in 1972 to consolidate academic and administrative data processing facilities. A Digital Equipment Corporation DECSYSTEM-10 computer was acquired to meet the computing needs of the campus.

In 1977, the center acquired a DECSYSTEM-2050 to meet increased user needs. This system was expanded several times and is presently classified as a DECSYSTEM-2065. In 1982 a DECSYSTEM-2020 computer was installed and in 1984 a second DECSYSTEM-2020 was purchased from Eastern Montana College. A VAX 11/785 super minicomputer was acquired with student computer fees during 1984. In addition, the Computer Science Department operates a VAX 11/750 super minicomputer.

COMPUTER CENTER ORGANIZATION AND STAFFING

The following chart depicts the organizational structure of the Computer Center.

ORGANIZATION OF THE UNIVERSITY OF MONTANA COMPUTER CENTER



Source: Computer Center, University of Montana

Illustration 1

The Computer Center has a staff of 33.6 FTE. The 33.6 FTE consist of 12.1 FTE for Computer Center Operations, 18 FTE for Administrative Information Systems, 1.5 FTE for Telecommunications, an administrative assistant and the Computer Center director.

The Telecommunications section was recently created. This section's primary responsibility is the university telephone system.

The Administrative Information Systems section provides software application development, programming, production, and data entry services.

The Computer Center Operations section consists of system software specialists and various operations personnel who keep UofM's major computers and system software operational. This section also provides user assistance with various computing methods and techniques and software applications available on UofM computers.

FUNDING AND EXPENDITURES

Computer Center data processing activities are funded from two different sources. Part of the university's appropriation is directly allocated to an administrative computer fund which is divided among campus departments. Department computer charges are deducted from each department's allocation. The administrative computer fund money is earmarked for use by the Computer Center for operations.

Auxiliary departments, off-campus accounts, and grant and contract work are the only sources of direct reimbursement the Computer Center receives for the computer services it provides. In fiscal year 1983-84 approximately \$40,000 of \$1.26 million in computer services provided were directly reimbursed.

Computer Center expenditures for fiscal year 1983-84 are shown in the following illustration.

COMPUTER CENTER EXPENDITURES - UNAUDITED
Fiscal Year 1983-84

	<u>Center Operations</u>	<u>Administrative Production</u>	<u>Administrative Development</u>	<u>Total</u>
Personal Services	\$357,780	\$121,510	\$388,935	\$ 868,225
Operating Expenses	323,520	3,159	6,511	333,190
Equipment & Buildings	62,905			62,905
Total Expenditures	<u>\$744,205</u>	<u>\$124,669</u>	<u>\$395,446</u>	<u>\$1,264,320</u>

Source: Statewide Budgeting and Accounting System

Illustration 2

Another source of funding for data processing activities is a student computer fee. At all units of the Montana University System, a computer fee of \$1 per quarter per credit hour (up to a maximum of twelve credit hours) is assessed for all students. Board of Regents policy states that this money is to be used for purchase or lease of computer hardware and software for instructional purposes. It may not be used for recurring personnel services. In fiscal year 1983-84, \$285,000 in student computer fees were collected. The student computer fee money for fiscal years 1983-84 and 1984-85 is being used to purchase the VAX 11/785 and numerous microcomputers for academic departments.

COMPUTER CENTER RESPONSIBILITIES

The Computer Center's major responsibility is to provide the university with the necessary computing resources to efficiently and effectively operate. The Computer Center has evolved from a small, basic needs operation serving limited campus users, to a general purpose service facility providing computing resources for the instructional, research, and administrative activities of the university and various off-campus users. The center also provides development and production services to campus administrative offices, consulting services to students and faculty, and operational and technical support services to the entire campus. Production

services include running batch data processing software applications for users and reconciling application output. Short courses and training seminars are provided by Computer Center User Services to help educate users on the various features available on university computers.

COMPUTER USERS ADVISORY COMMITTEE

A Computer Users Advisory Committee (comprised of students, faculty, and staff) serves in an advisory role to the Computer Center director and university administration. This committee provides computer users input for campus data processing decisions. The committee has made some specific recommendations related to campus word processing and the use of the student computer fee.

MAJOR COMPUTER EQUIPMENT

UofM has five major computers. The following illustration summarizes the university's major computers, date the computer was installed, purchase costs, and primary users.

MAJOR COMPUTER EQUIPMENT
UNIVERSITY OF MONTANA
 Fiscal Year 1984-85

<u>Type</u>	<u>Description</u>	<u>Installation Date</u>	<u>Purchase Costs Including Upgrades</u>	<u>Primary Users</u>
DECSYSTEM-2065A	Large, mainframe computer system	1977	\$1,245,800	Administrative and Academic
DECSYSTEM-2020B	Medium, mainframe computer system	1982	\$ 73,000	Academic
DECSYSTEM-2020C	Medium, mainframe computer system	1984	\$ 30,000	Academic
VAX 11/785	Large, super minicomputer system	1984	\$ 302,163	Upper Division Academic
VAX 11/750*	Mid-sized, super minicomputer system	1982	\$ 147,565	Computer Science Department

*Located at the Computer Science Department, University of Montana.

Source: Computer Center, University of Montana

Illustration 3

MICROCOMPUTERS

Microcomputer use at the university has increased significantly in the last five years. Five years ago there were no microcomputers on campus. Presently there are 88 microcomputers on campus with another 28 on order. Of the 88 microcomputers on campus, 80 are used for academic purposes.

Currently UofM has no microcomputer policies except for those pertaining to microcomputer purchases. Formal microcomputer policies have not been developed because the use of microcomputers on campus has grown tremendously in the last few years and the university officials have concentrated on other issues. Computer

Center officials indicated they plan on developing policies and procedures.

Formal microcomputer policies and procedures would make university microcomputer users aware of university positions and policy on specific issues and also provide general guidelines for operating and using microcomputers. The university should consider the following when developing formal microcomputer policies.

- Ownership rights of software developed by university faculty, students, and staff.
- Types of controls to consider when developing custom software.
- Acquisition and use of vendor software.
- Storage of backup software and data.
- Physical security of microcomputer hardware and software.

CHAPTER III

COMPUTER CENTER FACILITY

The UofM operates a central Computer Center which serves all campus departments. The Computer Center provides computing resources for instructional, research, and administrative activities at the university. Processing is performed on a DECSYSTEM-2065, two DECSYSTEM-2020s, and a VAX 11/785. Computing resources are generally available 24 hours a day, seven days a week.

UofM COMPUTER CENTER FACILITY

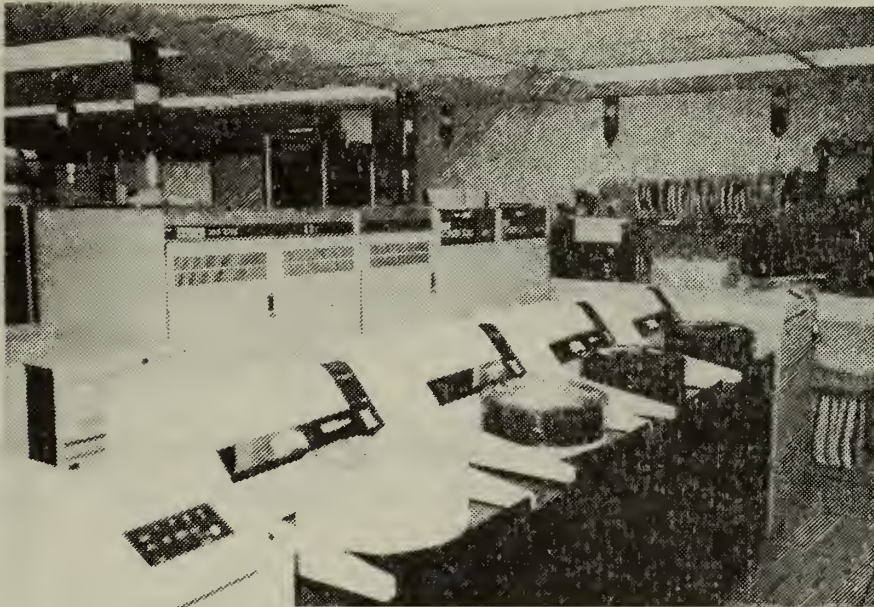


Illustration 4

During our audit we reviewed specific controls which pertain to the Computer Center. The following sections discuss our suggestions for improvements.

MAINTENANCE CONTRACTS

Scheduled maintenance is performed weekly on the DECSYSTEM-2065, once a month on the DECSYSTEM-2020B, and every ninety days on the VAX 11/785, which is under warranty until

February 1, 1985. The DECSYSTEM-2020C is not covered under any written maintenance agreements. The Computer Center also has no formal written agreement for maintenance on the VAX 11/785 after the warranty expires on February 1. As a result, two of UofM's major computer systems are not covered by a written maintenance agreement.

The Computer Center has a 24-hour written maintenance agreement for the DECSYSTEM-2065, DECSYSTEM-2020B, and for various campus computer terminals at an annual cost of \$113,928. The Computer Science Department has a separate maintenance agreement on the VAX 11/750 which costs \$9,540 annually.

Computer Center officials are aware of the weakness and are currently examining a maintenance agreement which should cover all major Computer Center hardware for about \$125,000 a year. We believe the university should conclude a formal written maintenance agreement as soon as possible to ensure that computer hardware is adequately maintained.

RECOMMENDATION #1

WE RECOMMEND UofM CONCLUDE A FORMAL WRITTEN MAINTENANCE AGREEMENT COVERING ALL MAJOR COMPUTER HARDWARE.

POWER PROTECTION SYSTEM

Computer hardware failure may be caused by increases or decreases in the specified voltage of an external power supply. Some type of power protection is necessary so that computer operations are not disrupted. At this time, the Computer Center has no such power protection.

During our review of the Computer Center's operation logs for a three-month period (September through November 1984), we noted that the DEC-2065 was inoperable (down) seven times, the DEC-2020B was down six times, and the DEC-2020C was down four times due to fluctuations in power. These disruptions in operation caused lost time to Computer Center personnel and to specific

users. For example, in October 1984 a problem with the DECSYSTEM-2065 resulted in the loss of hundreds of student records. As of December 1984, the Admissions Office had expended more than 65 hours to restore the student records lost during the incident and had not completed restoration of all the lost records.

We believe the university should purchase a power protection system for the Computer Center. The university has three options:

1. Purchase a power distribution system which will even out minor power fluctuations and protect the hardware from power surges. The cost for such a system would be about \$23,000 according to one vendor.
2. Purchase a power distribution system and a generator. This system protects the computers from power surges and evens out minor power fluctuations. In addition, minor power fluctuations will not cause a disruption. This combination would be substantially more expensive than the power distribution system. A similar system now used at Montana State University would cost \$60,000 to replace.
3. Purchase an uninterruptable power supply (UIP). A UIP does all of the above plus it allows a controlled shutdown of the system in the event of a power outage. This aids in the recovery of software applications which were running at the time of the disruption. A UIP system similar to the state Department of Administration's would cost approximately \$100,000.

RECOMMENDATION #2

WE RECOMMEND UofM ANALYZE THEIR NEEDS AND PURCHASE A POWER PROTECTION SYSTEM FOR THE COMPUTER CENTER.

ADEQUACY OF FACILITY SPACE

The location, layout, and physical construction of the data processing department can affect its processing capabilities. The UofM Computer Center is located in the basement of a campus academic building on the same floor as a classroom and a campus terminal room.

By being located on the same floor as a classroom as well as a public terminal room, traffic is heavy around the Computer Center. Unnecessary traffic increases the possibilities of loss of data from human errors and abuses.

Space is also a problem for the Computer Center. The current computer room is crowded. As a result, the computer operators and some equipment normally in the computer room are located in an adjacent office. The following picture shows current computer room conditions.

UofM COMPUTER ROOM

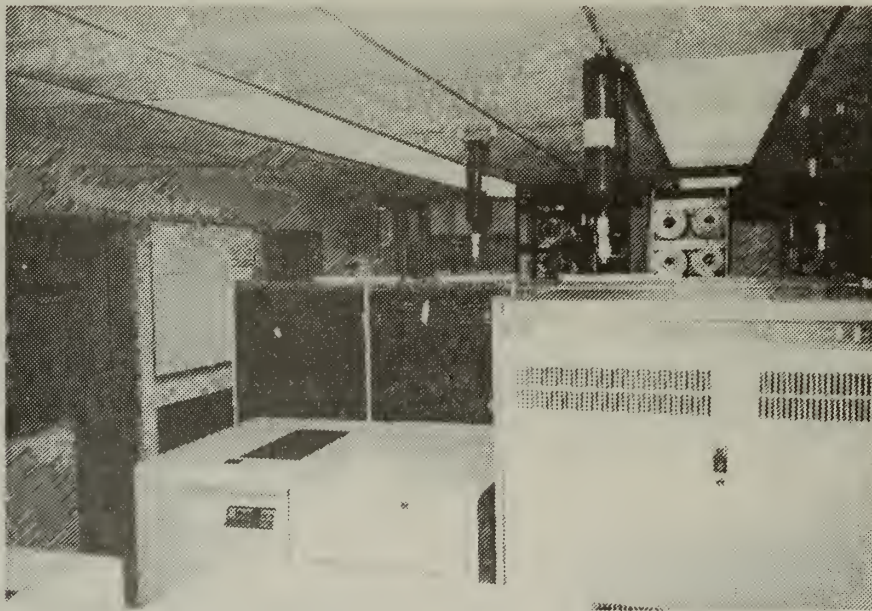


Illustration 5

Most available space is being used for offices for personnel so paper supplies are stored in the hallways. This poses a potential fire hazard and it increases the possibility of theft of paper. Paper storage is shown in the following picture.

COMPUTER CENTER PAPER SUPPLY STORAGE

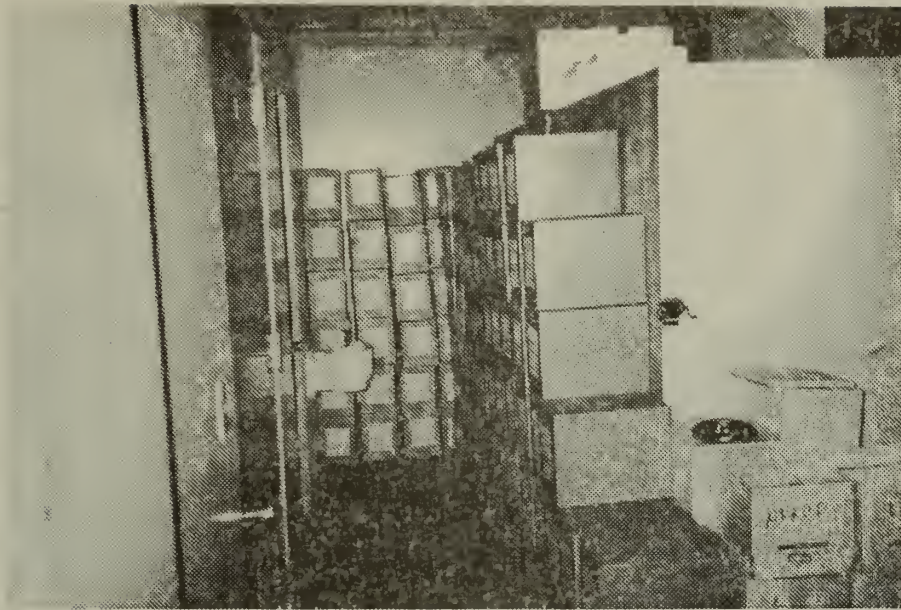


Illustration 6

Office space is also insufficient. The Computer Operations manager is currently housed in an office whose only access is through the computer room. This arrangement causes undue traffic through the computer room. The halon fire extinguishers located in the computer room also pose a safety hazard. The halon devices will extract all the oxygen from the computer room in the event of a fire and it is unlikely that the Operations Manager will receive adequate advance warning to be able to evacuate before the halon devices are set off.

OPERATIONS MANAGER'S OFFICE INSIDE COMPUTER ROOM*

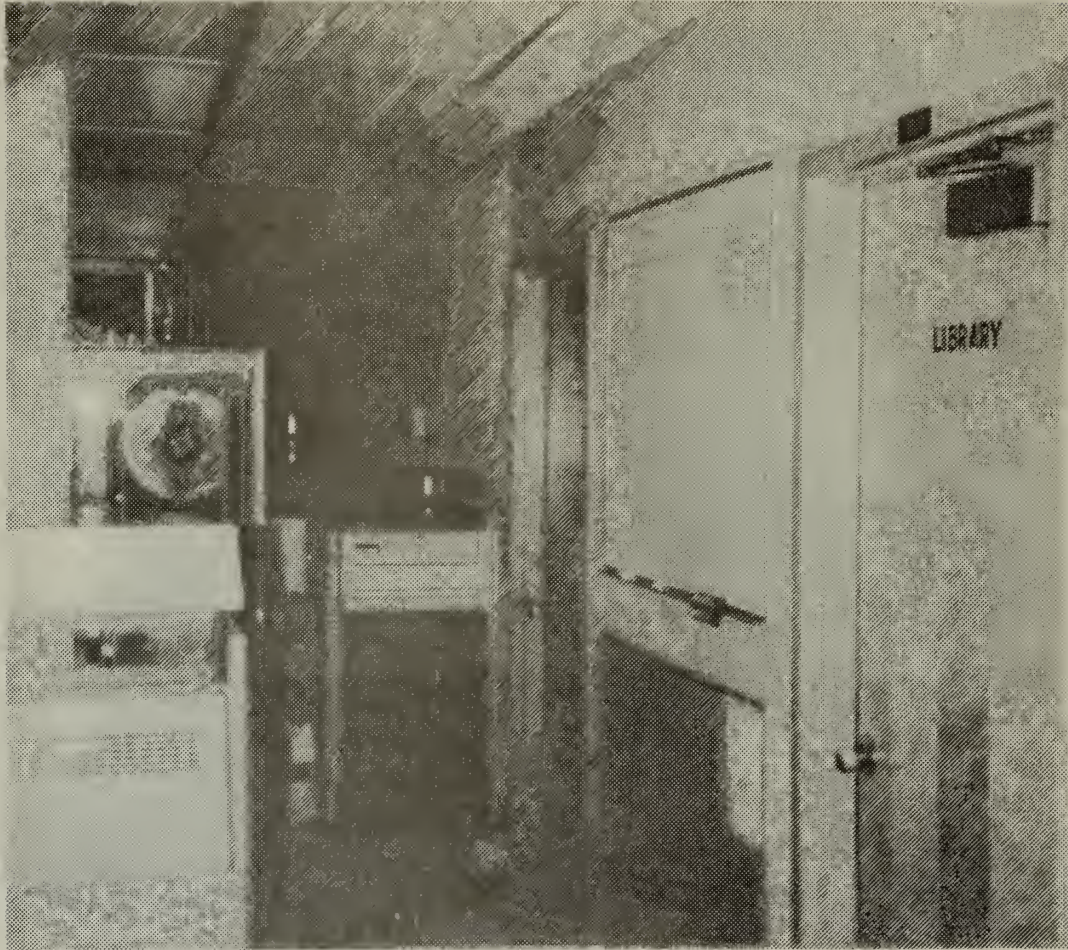


Illustration 7

*The door marked LIBRARY is the Operations manager's office.

We believe the university should consider placing its computer facility in a new or existing building which would allow additional space. The type of building makes little difference. For example, Washington State University placed its Computer Center under the stands on one side of its football stadium.

RECOMMENDATION #3

WE RECOMMEND UofM EXAMINE ALTERNATIVE LOCATIONS FOR THE COMPUTER FACILITY.

DISASTER RECOVERY

With any computerized operation, backup and disaster recovery planning are important activities. UofM would experience problems operating without its computer systems. Adequate backup and recovery planning minimizes the inconvenience in the event of a disaster at the computer facility. We believe some disaster recovery policy decisions and improvements to the disaster recovery planning would be beneficial.

The occurrence of a problem which would require a disaster recovery effort may appear remote but it could occur at any time. During our review, the center experienced a power problem which caused a total system shutdown. Luckily, the damage was minor but it could have disabled UofM's Computer Center.

Disaster Recovery Policy Issues

UofM and Eastern Montana College (EMC) have an informal mutual disaster recovery backup agreement. This agreement is the primary short-term processing alternative for both universities. We did not find any written agreement on some issues which we believe to be important, including:

1. How long should the host unit count on providing back-up service?
2. What types of resources are necessary to process the other unit's critical applications?
3. Are the operating systems and hardware being kept concurrent and, if not, what steps are necessary to compensate?

We suggest UofM management establish a memorandum of understanding with EMC.

RECOMMENDATION #4

WE RECOMMEND UofM FORMALIZE ITS MUTUAL BACKUP AGREEMENT WITH EMC.

Disaster Recovery Plan

During our review, we found that the Computer Center has not formalized their disaster recovery plan. At this time only a "rough draft" exists which was developed as an outline in May 1983.

The center's present plan is a good base which could be expanded upon. The plan could include, in detail, such areas as:

1. Data: Listing all off-premises master files - their date, location, and procedures for updating.
2. Hardware: Giving a listing of current inventory.
3. Software: Giving location and arrangements for off-premises backup.
4. Personnel: Listing names and phone numbers of Computer Center management, data processing personnel, and current vendor representatives.
5. Supplies: Listing special forms and supplies stored off-premises.
6. Documentation: Listing the location of backup tapes of source code, application run manuals, and operator manuals.
7. Facilities: Describing space and support services such as telephone lines.

The current plan addresses most of these areas although more detail may be desirable. Any information not in the current plan is available and only needs to be consolidated in the plan.

The plan could also address some policy issues related to disaster recovery. These include:

1. What activity will be off loaded to make room for EMC to process? (It is improbable that either university has sufficient capacity to process its own activity plus the other university's.)
2. Given the limited amount of capacity available at EMC, which applications will be transported to the other site? Some flexibility as to order will be necessary depending on where in the month or quarter the problem occurs.

3. What will become of non-priority applications? The users should be informed of their priority status so they can make alternative arrangements.
4. How are student users going to be accommodated?

The disaster recovery plan should be fully documented and cover several levels of disruption. It also should be relayed to all center personnel to ensure their specific functions in the event of a disaster are known. During our audit we found personnel who did not know any details of their disaster duties and were not familiar with the center's present disaster plan.

The current draft plan calls for testing to assure the minimization of problems in the event of a real emergency. We did not find evidence of such testing, although the center has had some situations where the staff had to start taking recovery actions. During the audit, we asked the center to simulate recovery of the payroll system. The Computer Center experienced few problems during the recovery exercise and handled these problems appropriately. We believe the exercise was useful to the center for identifying potential problem areas. We suggest the center conduct other such exercises, when feasible, to improve their preparedness.

The Computer Center should formalize its disaster recovery plan, communicate the required tasks more effectively to the staff, and conduct periodic disaster recovery exercises.

RECOMMENDATION #5

WE RECOMMEND THE COMPUTER CENTER:

- A. FORMALIZE ITS DISASTER RECOVERY PLAN.
- B. COMMUNICATE THE REQUIRED TASKS TO THE STAFF.
- C. CONDUCT PERIODIC DISASTER RECOVERY EXERCISES.

CHAPTER IV

SOFTWARE APPLICATION DEVELOPMENT AND MAINTENANCE

The Administrative Information System section of the Computer Center is responsible for the design, development, installation, and maintenance of software applications. These software applications consist of instructions which tell the computer how to process certain tasks such as calculating net pay as part of a payroll software application. Development of an application involves defining the needs of the user, designing the application, developing it, testing it, and finally installing it. Maintenance includes providing specific support to the users of the application such as correcting any errors which may prevent the application from running as designed or making modifications which would improve the application.

The illustrations below show Administrative Information System's software application development and maintenance costs for selected applications for fiscal years 1982-83, 1983-84, and the first half of 1984-85.

SOFTWARE APPLICATION DEVELOPMENT COSTS
FOR SELECTED APPLICATIONS
 Fiscal Years 1982-83 through 1984-85

<u>Software Application</u>	<u>Fiscal Year</u> <u>1982-83</u>	<u>Fiscal Year</u> <u>1983-84</u>	<u>Fiscal Year</u> <u>1984-85</u> ¹	<u>Total Develop-ment</u> <u>Costs</u> ²
Electronic Funds Transfer	\$ -0-	\$21,606	\$ 9,018	\$ 30,624
Physical Plant Inventory System	11,661	40,118	2,916	54,695
Advanced Registration	483	44,200	84,591	129,274
Alumni/Foundation	62,468	76,492	-0-	138,960
Accounts Receivable	90,620	-0-	-0-	90,620
Financial Aids	85,100	41,132	1,350	127,582

¹Cost figures for the first six months of fiscal year 1984-85.

²These costs only include the cost of staff time and do not include related computer costs. Complete information is not available for computer costs associated with these projects.

Source: Computer Center, University of Montana

Illustration 8

MAINTENANCE COSTS FOR SELECTED SOFTWARE APPLICATIONS¹
 Fiscal Years 1982-83 through 1984-85

<u>Software Application</u>	<u>Fiscal Year</u> <u>1982-83</u>	<u>Fiscal Year</u> <u>1983-84</u>	<u>Fiscal Year</u> <u>1984-85</u> ²	<u>Total Maintenance</u> <u>Costs</u>
Accounts Receivable	\$5,198	\$ 6,240	\$ 945	\$12,383
Claims	3,059	130	135	3,324
Payroll	6,072	21,710	6,453	34,235
Alumni/Foundation	161	17,628	11,178	28,967

¹These costs only include the cost of staff time and do not include related computer costs. Complete information is not available for computer costs associated with the maintenance work.

²Cost figures for the first six months of fiscal year 1984-85.

Source: Computer Center, University of Montana

Illustration 9

SOFTWARE APPLICATION DEVELOPMENT

During our audit of Computer Center activities we reviewed the center's software application development process to determine what controls are in place. During fiscal year 1983-84, center development staff completed five development projects. Another nine development projects are currently in progress. Payroll electronic funds transfer, student preregistration, and general purchasing are examples of recently developed applications or applications that are currently in progress.

Software Application Development Process

The software application development process should include reasonable controls to ensure that application development resources are efficiently and effectively used and the application processes information according to specifications. During our review we noted areas where the Computer Center's software application development process could be improved.

1. Cost/Benefit Analysis - The Computer Center conducts limited cost/benefit analysis for software applications they develop. Currently UofM has a much greater demand for computer and application development resources than can be met. Without comparison of costs and benefits, university officials may not be allocating these resources efficiently and effectively.
2. Formal Post-Implementation Review - Computer Center officials do not conduct formal reviews of software applications developed by the center after the applications have been implemented by the user departments. Without a post-implementation review, problems with applications may be treated as isolated instances and the real cause of the problems may not be determined. The post-implementation review may help university management to determine how actual benefits and costs compare to estimates, if the application performs as envisioned, and if adequate controls are in place and functioning.
3. Formal Approval by User Management - User management informally approves each phase in the development process, but there is no formal written approval of various phases during the development process. Without

formal prior approval of each phase of the software application development process there is a possibility that a software application could be completely developed, and the user not be satisfied. As a result, the user may have to request changes which should have been made when the application was being developed.

4. Formal Software Application Conversion Standards and Plans - No formal conversion standards or plans exist. The conversion plans would help assure that software applications are converted consistently, accurately, and completely.
5. Testing Practices and Procedures - The Computer Center should improve standards for testing completed programs and applications. With improved testing standards there is more assurance that software applications are consistently and adequately tested.

Final acceptance tests are not conducted for software applications developed by the Computer Center staff. If a final acceptance test is not done, there is a possibility that an application may not work and deficiencies may not be noted until the application is implemented.

The Computer Center should develop policies and procedures to ensure that adequate cost/benefit analysis, post-implementation review, formal approval, conversion planning, and testing of software applications are conducted.

RECOMMENDATION #6

WE RECOMMEND THE COMPUTER CENTER IMPROVE SOFTWARE DEVELOPMENT POLICIES AND PROCEDURES.

External Software Development

A limited number of computer software applications are developed by the Computer Center. The remaining requested applications are either not developed, or are developed outside the Computer Center at the expense of the requesting department. Some campus departments utilize private consultants or computer science students to develop software applications because the applications they wish to develop are not given high priority by the university.

In our EDP audit work we noted an example where computer science students developed a software application for a campus department which was never implemented. The Computer Center director did not authorize allocation of computer space to run the application because Computer Center officials believe the application was designed in such a manner that it could not be implemented. University resources were expended, yet the application was not implemented.

Currently, software applications developed for campus departments by private consultants and computer science students are not coordinated with the Computer Center. Without coordination of software applications being developed on campus, the Computer Center cannot effectively manage available hardware capacity. In addition, there is no assurance that software applications are not being unnecessarily duplicated on campus.

The university should develop policies and procedures that ensure that all mainframe software application development work is coordinated with the Computer Center.

RECOMMENDATION #7

WE RECOMMEND UofM ADOPT POLICIES AND PROCEDURES SO THAT ALL MAINFRAME SOFTWARE APPLICATION DEVELOPMENT WORK IS COORDINATED WITH THE COMPUTER CENTER.

SOFTWARE APPLICATION MAINTENANCE

During the audit we examined the software application maintenance process and related maintenance controls. The software application maintenance process should provide assurance that application maintenance is performed completely and accurately. We noted two areas where the maintenance process could be improved. These areas include better project documentation and project review.

1. Project Documentation - During our field work, we reviewed a sample of 20 software maintenance requests.

We found little documentation concerning who requested the change, what type of software application was being changed, or what tests were performed before the change was implemented. We also noted some examples where supporting documentation for software applications was not regularly updated. To ensure that there are administrative procedures for review of all phases of software maintenance projects, as well as to adequately control each, all requested changes should be supported by a formal maintenance request.

2. Project Review - During our review we also found that there is little formal review of software maintenance projects by supervisory personnel. A request is normally given to a programmer who not only makes the change but also tests and implements it. To reduce the possibilities of errors occurring in these changes, as well as assuring the work is performed completely and standards are followed, an independent or supervisory review should be performed periodically on software maintenance projects.

The Computer Center should develop policies and procedures to ensure that application maintenance projects are adequately documented and reviewed.

RECOMMENDATION #8

WE RECOMMEND THE COMPUTER CENTER IMPROVE SOFTWARE MAINTENANCE POLICIES AND PROCEDURES.

CHAPTER V

COMPUTER RESOURCES, DECSYSTEM MIGRATION, AND FUNDING

At the beginning of the audit, UofM officials indicated current data processing capacity of the DECSYSTEM-2065 was not adequate to meet the needs of the university. Limited logon access and slow system response were the major problems noted by UofM officials. During our field work, we examined the processing capacity of UofM's major computer system, the DECSYSTEM-2065. The next three sections discuss the demand for Computer Center resources, the DECSYSTEM migration and computer funding at UofM.

DEMAND FOR COMPUTER RESOURCES

Our own observation of UofM computer systems over a period of about two months confirmed that data processing users were experiencing problems with logon access and slow system response. We contacted eleven users from four administrative offices to determine if they have had problems logging on to the DECSYSTEM-2065 or with system response. All administrative users that we contacted indicated that they routinely experience some kind of access or response problems when using the DECSYSTEM-2065. For example, one user conducted a five-day time study and found that it took $7\frac{1}{4}$ hours of queue time to process $2\frac{1}{2}$ hours of work.

Computer Center officials indicated that recently developed or planned software applications will require additional capacity to operate as originally designed. For example, the Physical Plant's Central Stores Inventory application currently being developed by the Computer Center is primarily an on-line, interactive application which requires good accessibility and response time from the DECSYSTEM-2065. The university has also decided to develop or buy a Purchasing/Payables application which is also an on-line, interactive application.

According to Computer Center officials, present university data processing hardware will not facilitate the satisfactory use of

additional on-line, interactive applications such as Central Stores Inventory and a new Purchasing/Payables application. Based on our observation of current processing problems and the resource requirements of on-line, interactive applications, we concur with this conclusion. As a result, the university is expending resources to develop or acquire applications for which the university currently lacks capacity to run effectively.

Recent efforts to move some DECSYSTEM-2065 users to the DECSYSTEM-2020s and the VAX 11/785 and recent upgrades of the DECSYSTEM-2065 have had limited effect on the current hardware capacity problem.

In planning for the upcoming biennium, the university identified 70 requests by campus departments for software applications. Due to current hardware capacity and Computer Center development staff limitations, only five to ten of these requests can be completed each year. While the cost/benefit of each request has not been explored by the university, the magnitude of the requests in relation to those which can be completed indicates a large degree of unmet demand. This was further reinforced when we noted that some departments were contracting with outside parties to develop applications.

Another area where demand is high is Computer Center User Services. User Services provides a variety of training classes to users of UofM computer systems. Classes range from an introduction to UofM computer facilities and organization to more technical areas such as electronic mail and computer graphics.

Over the past two years User Services has had to turn away approximately 20 percent of all persons interested in taking the classes they offer. This compounded with the increased variety and complexity of computer hardware and software being used adds to the number of uninformed users. Those interested in gaining a better understanding of computing methods and techniques are not able to. As a result, users may be spending their time ineffectively using the computer and may not be using computer capacity effectively due to lack of knowledge.

DECSYSTEM MIGRATION

In mid-1983, DEC announced that it was discontinuing production of the DECSYSTEM 20 series computers. At that time, DEC said that it would support the 20 series software for at least five years and the hardware for up to ten years.

As support for DECSYSTEM 20 computers diminishes, hardware maintenance rates may rise making it economically unattractive to keep the 20 series computers, and support for the DECSYSTEM operating system may degrade causing more work for UofM's software specialists.

UofM has some options for migration of its data processing activities including:

- DEC's VAX line of super minicomputers.
- A successor to the DEC 20 series computers under development by a private firm in cooperation with Stanford University.
- The use of VAX super minicomputers for university research and instruction and the use of some other hardware for the university administration.

Any of these alternatives could work for UofM but each would require a significant appropriation to implement successfully. Another complicating factor is that UofM should start the migration this biennium to allow for a controlled transfer and to prevent a large future outlay of funds.

FUNDING

Excluding auxiliary departments, off-campus accounts and grant and contract work, the Computer Center is not directly reimbursed for the computer services it provides. As previously noted, in fiscal year 1983-84 approximately \$40,000 of \$1.26 million in computer services provided were directly reimbursed. These users are not funded by the state General Fund and depend upon other funding sources for their operations.

The Computer Center has developed billing rates for actual computer use, software application development, and production

services. Individual departments are allocated funds for these three areas. Within the administrative computer fund, expended amounts can exceed original department allocations in specific areas and also exceed the total amount allocated to the department. If a department expends more than its allocation, the overexpense will be absorbed within the fund by another department that did not expend all of its allocation. Because of the administrative computer fund arrangement, campus departments are not being directly charged for computer services.

We reviewed Computer Center billing records for fiscal year 1983-84 and found that some departments which have funding sources other than the state General Fund are not being directly charged for computer services provided by the Computer Center. These services are being charged against the administrative computer fund which is General Fund money. For example, the Alumni/UofM Foundation used about \$144,200 of computer services provided by the Computer Center during fiscal year 1983-84.

We believe that entities which have outside sources of funding should directly pay for any services provided by UofM. The Foundation and Alumni Office are separate entities from the university and as such should not receive funding support from the university.

SUMMARY

During our review, we noted that UofM projected demand for data processing cannot be met with current resources. In addition, UofM will need to migrate from the DECSYSTEM 20 series computers.

The current Computer Center budget is not sufficient to begin the migration or provide additional data processing resources. UofM will have to explore other funding sources to meet data processing demands. The university may acquire additional funds for data processing by charging more users or reallocating administrative funds.

UofM's five-year plan for computing identifies unmet computing requests at UofM. The plan does not include a current detailed

analysis of present and future computing use. The analysis should include such information as types of users, the resources required by the types of users, and the time of day of use.

With more detailed information on computing resource uses and requests, university officials can better determine the amount and type of computing resources needed. Then, UofM officials can conduct more detailed capacity planning than is currently available and can better evaluate which demands are cost justifiable.

RECOMMENDATION #9

WE RECOMMEND UofM:

- A. DOCUMENT COMPUTING RESOURCE DEMANDS IN MORE DETAIL.
- B. CONDUCT MORE DETAILED CAPACITY PLANNING AND EVALUATE WHICH DEMANDS ARE COST JUSTIFIABLE.

AGENCY RESPONSE



University of Montana

Vice President for Fiscal Affairs • Missoula, Montana 59812 • (406) 243-2311

March 11, 1985

Mr. Richard Varner
EDP Audit Supervisor
Office of the Legislative Auditor
Room 135
State Capitol Building
Helena, MT 59620

RECEIVED

MAR 11 1985

MONTANA LEGISLATIVE AUDITOR

Dear Dick:

This letter provides the University's response to the EDP Audit Report dated March 4, 1985. Please contact either Steve Henry or myself if you have any questions or comments prior to our meeting with the Legislative Audit Committee.

Regarding that meeting, please recognize that the University administration has many commitments during the Legislative Session which may conflict with potential meeting dates or times. I would appreciate discussing the date for the committee review as soon as possible so that we may avoid conflict.

Best regards,

Glen I. Williams
Vice President for
Fiscal Affairs

Glw:bd

cc: Steve Henry, Computer Center
Sylvia Weisenberger, Internal Audit

Attachment

LEGISLATIVE EDP AUDIT REPORT FOR THE UNIVERSITY OF MONTANA
UNIVERSITY OF MONTANA RESPONSE
March 11, 1985

Chapter I -- Introduction

The University finds no factual inaccuracies in Chapter 1 of the EDP Audit Report. The University prefers not to address at this time any of the management memoranda listed in Chapter 1.

Chapter II -- Background

The University finds no factual inaccuracies in Chapter 2 of the EDP Audit Report. Regarding microcomputer policies discussed on pages 7 and 8 of the EDP Audit Report, we wish to note that the University presently is developing policies concerning the use of microcomputers for administrative applications (including the development of custom software) and the acquisition and use of vendor software.

Chapter III -- Computer Center Facility

The University finds no factual inaccuracies in Chapter 3 of the EDP Audit Report.

RECOMMENDATION #1 -- Maintenance Contracts

"WE RECOMMEND UoFM CONCLUDE A FORMAL WRITTEN MAINTENANCE AGREEMENT COVERING ALL MAJOR COMPUTER HARDWARE."

The University concurs with the recommendation.

We wish to note, however, that the University has had continuous contracted maintenance coverage for its major computer hardware since 1972, and in fact such a contract presently is in force for equipment on site as of July 1, 1984. Since August, 1984, the University and Digital Equipment Corporation (DEC) have been negotiating an extension to the present agreement, which will cover all of the University's major equipment, including that acquired since July 1, 1984. That extension will result in a comprehensive agreement for Fiscal 1984-85 which will provide coverage retroactive to July 1, 1984, for approximately the same cost as the present contract coverage. The negotiation has been complex because the amount of equipment acquired by the University over the past several months resulted in frequent changes to the equipment configuration and the effective dates of maintenance coverage. The process currently is now virtually complete, however.

During this period, only the DECSYSTEM-2020 acquired from Eastern Montana College has not been formally protected; the newly acquired VAX-11/785 has been under warranty protection. Also, the University has an interim agreement with DEC to provide coverage for all of the University's major computer equipment, including the EMC DECSYSTEM-2020. In fact, substantial work has been performed under that agreement when required, on each of the University's major computer systems.

RECOMMENDATION #2 -- Power Protection System

"WE RECOMMEND UoFM ANALYZE THEIR NEEDS AND PURCHASE A POWER PROTECTION SYSTEM FOR THE COMPUTER CENTER."

The University concurs with the recommendation.

We will study the appropriate type of power protection system, to be purchased when funding permits.

RECOMMENDATION #3 -- Adequacy of Facility Space

"WE RECOMMEND UoFM EXAMINE ALTERNATIVE LOCATIONS FOR THE COMPUTER FACILITY."

The University concurs with the recommendation.

The University has long been aware of the problem inherent in the present Computer Center location. However, the University's overall space needs and its general lack of available space provide few alternatives for relocating the Computer Center, other than new construction. We will reexamine existing alternatives.

RECOMMENDATION #4 -- Disaster Recovery Policy Issues

"WE RECOMMEND UoFM FORMALIZE ITS MUTUAL BACKUP AGREEMENT WITH EMC."

The University concurs with the recommendation.

We will pursue a memorandum of understanding as suggested in the EDP Audit Report.

RECOMMENDATION #5 -- Disaster Recovery Plan

"WE RECOMMEND THE COMPUTER CENTER:
A. FORMALIZE ITS DISASTER RECOVERY PLAN.
B. COMMUNICATE THE REQUIRED TASKS TO THE STAFF.
C. CONDUCT PERIODIC DISASTER RECOVERY EXERCISES."

The University concurs with the recommendation.

We will formalize our disaster recovery plan and procedures as suggested in the EDP Audit Report.

Chapter IV -- Software Application Development and Maintenance

The University finds no factual inaccuracies in Chapter 4 of the EDP Audit Report.

RECOMMENDATION #6 -- Software Application Development Process

"WE RECOMMEND THE COMPUTER CENTER IMPROVE SOFTWARE DEVELOPMENT POLICIES AND PROCEDURES."

The University concurs with the recommendation.

However, we wish to note the following points:

1. Cost/Benefit Analysis - The University recognizes the value of cost/benefit analysis for software applications. However, the number of requested development projects is quite large relative to the size of the development staff (page 25 of the EDP Audit Report notes that 70 requests were identified for the upcoming biennium; the development staff consists of 14 people). This precludes performing detailed cost/benefit analyses for all requested projects prior to administrative evaluation. Instead, cost/benefit estimates are used for administrative review. Detailed cost/benefit analyses are included in the initial development phase of approved projects, to ensure that development of cost-ineffective applications or features is not undertaken.
2. Formal Post-Implementation Review - We agree.
3. Formal Approval by User Management - We agree.
4. Formal Software Application Conversion Standards and Plans - We understand software application conversion requirements and considerations, but conversion situations have arisen so seldom, and have been so unique in circumstance (the conversion of the University's former accounting system to SBAS, for example) that we have chosen to handle the requirements of such conversions on a case by case basis.
5. Testing Standards and Practices - We believe that, in general, application software is thoroughly and adequately tested. However, we will work to establish uniform testing standards to ensure that testing procedures are uniform for all applications, to the extent practical. We agree with the recommendation regarding final acceptance testing.

RECOMMENDATION #7 -- External Software Development

"WE RECOMMEND UoFM ADOPT POLICIES AND PROCEDURES SO THAT ALL MAINFRAME SOFTWARE APPLICATION DEVELOPMENT WORK IS COORDINATED WITH THE COMPUTER CENTER."

The University concurs with the recommendation.

We note, however, that we are concerned not only with external development of mainframe software applications, but with microcomputer software applications also. We are working to develop policies and procedures which apply to all external software application development.

RECOMMENDATION #8 -- Software Application Maintenance

"WE RECOMMEND THE COMPUTER CENTER IMPROVE SOFTWARE MAINTENANCE POLICIES AND PROCEDURES."

The University concurs with the recommendation.

However, we wish to note the following points:

1. Project Documentation - Existing policy requires that adequate documentation be maintained concerning requested changes, including the application being changed, the type of change, the specific description of the change, and any pertinent analyst or programmer documentation concerning changes made, and so-called "FILCOMs" (automated "before and after" program source comparisons). Existing policy also requires that supporting application documentation be kept current. To the extent that this information is not being maintained or kept current, it is contrary to existing policy. We agree that a formal change request mechanism is needed, and we will review the overall policy for adequacy. Also, we will investigate adherence to the present policy.
2. Project Review - Existing policy requires that the systems analyst who assigns a software maintenance project initial his/her final approval on the project assignment checkoff list, indicating that supervisory review of the completed project has occurred. We will investigate the issue of supervisory review of software maintenance projects to determine its adequacy and adherence to existing policy and procedures.

Chapter V -- Computer Resources, DECSYSTEM Migration, and Funding

The University finds no factual inaccuracies in Chapter 5 of the EDP Audit Report.

RECOMMENDATION #9 -- Resource Demands and Capacity Planning

"WE RECOMMEND UoFM:

- A. DOCUMENT COMPUTING RESOURCE DEMANDS IN MORE DETAIL.
- B. CONDUCT MORE DETAILED CAPACITY PLANNING AND EVALUATE WHICH DEMANDS ARE COST JUSTIFIABLE."

The University concurs with the recommendation.

We wish to note that a detailed analysis of required capacity was not included in the University's five-year plan for computing because the purpose of the plan is to identify areas of unmet need, to indicate types (rather than

precise quantity) of required resources, and to explain why such resources are necessary to meet the needs identified. An analysis of usage trends over the past five years is summarized in the plan, however, and serves as the basis for projected needs.

During the course of the audit, we provided samples of capacity analyses which we previously conducted, which included information about types of use, types of users, specific resources used, times of day and academic quarter when uses occurred, etc., such as is suggested in the EDP audit report. We agree that this information must be updated before the replacement of the DECSYSTEM-20s can be accomplished.

Usage data are quite volatile, because needs and demands change rapidly, because capacity constraints influence usage patterns dramatically, and because the impact of changing resources (e.g., the addition of a second DECSYSTEM-2020 and the VAX-11/785) requires time to be felt, to stabilize, and to be analysed. A significant addition of new resources invalidates any previous analysis of capacity requirements, and no meaningful analysis can be performed until equipment capacity and configuration has been stable for a period of time.

We will perform a detailed capacity analysis during the coming months, as computer resources and usage patterns stabilize. Also, we are continuing an analysis of long-range administrative application needs, including capacity requirements. We expect to utilize this information as part of our capacity planning efforts.

